Space Weather Technical Forecast

Issued on Tuesday, 05 March 2024 at 01:29 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of isolated M-Class flares throughout. Slight chance of G1/Minor Storm conditions on Days 3 and 4 (07 and 08 Mar).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with a peak C2.4 flare at 04/0316 UTC from AR3602. There are currently ten sunspot regions on the visible disc, with the majority of regions appearing simple and stable at this time. The most complex regions are AR3595 in the northwest and AR3602 in the northeast. AR3595 showed little development, with a large and stable leader and smaller trailer region, but few other spots. AR3602 developed modestly with a moderately large lead spot, but poorly defined trailer region comprising of numerous small pores or spots. Separation between the lead and trailer regions increased during the period. This region is atypical due to its apparent north-south magnetic alignment.

No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Solar wind parameters observed at L1 by ACE indicated the ongoing, but gradually waning effects of one or more combined CMEs that arrived at Earth on 03 Mar. Solar wind speeds were largely slow-ambient, between 340-390 km/s, but became slightly elevated late in the UTC day on 04 Mar, peaking at 470km/s at 04/2138 UTC. Density was below average. Total magnetic field strength, IMF, was moderate throughout (peak 14nT at 03/0107 UTC, but on a generally declining trend. The north-south component varied between +13/-8nT, with mostly positive (northward) direction. Phi angle was positive (away from the Sun). Resultant Geomagnetic activity was Active (Kp4) from 04/0000-0300 UTC, but Quiet (Kp1-2) through the remainder of the period.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 was predominantly at background levels with the associated 24 hour fluence well below the Active (1e8 integrated pfu) threshold. The observed 24-hour fluence at 05/0000UTC was 1.03e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low with a chance of isolated Moderate activity, reducing to a slight chance by Day 4 (08 Mar).

Solar Wind / Geomagnetic Activity: A CME that left the sun on 03 Mar has a chance to give glancing impacts at Earth on Day 3 (07 Mar). No other CMEs feature in the forecast period. Residual effects from the CME that arrived on 03 Mar should diminish on Day 1 (05 Mar) with background to slightly enhanced solar winds expected to persist for much of, if not throughout the following days. A coronal hole high-speed stream enhancement is likely to occur late on Day 4 (08 Mar) with speeds predicted to increase to slightly elevated or elevated levels at peak.

Quiet to Unsettled geomagnetic activity is expected Day 1 (05 Mar), easing to Quiet from Day 2 (06 Mar). Activity may increase on Day 3 (07 Mar) with a chance of Unsettled to Active intervals and a slight chance of peak G1/Minor Storms if any CME enhancement occurs. On Day 4 (08 Mar) activity should increase late in the day to become Unsettled to Active, with a slight chance of G1/Minor Storm conditions.

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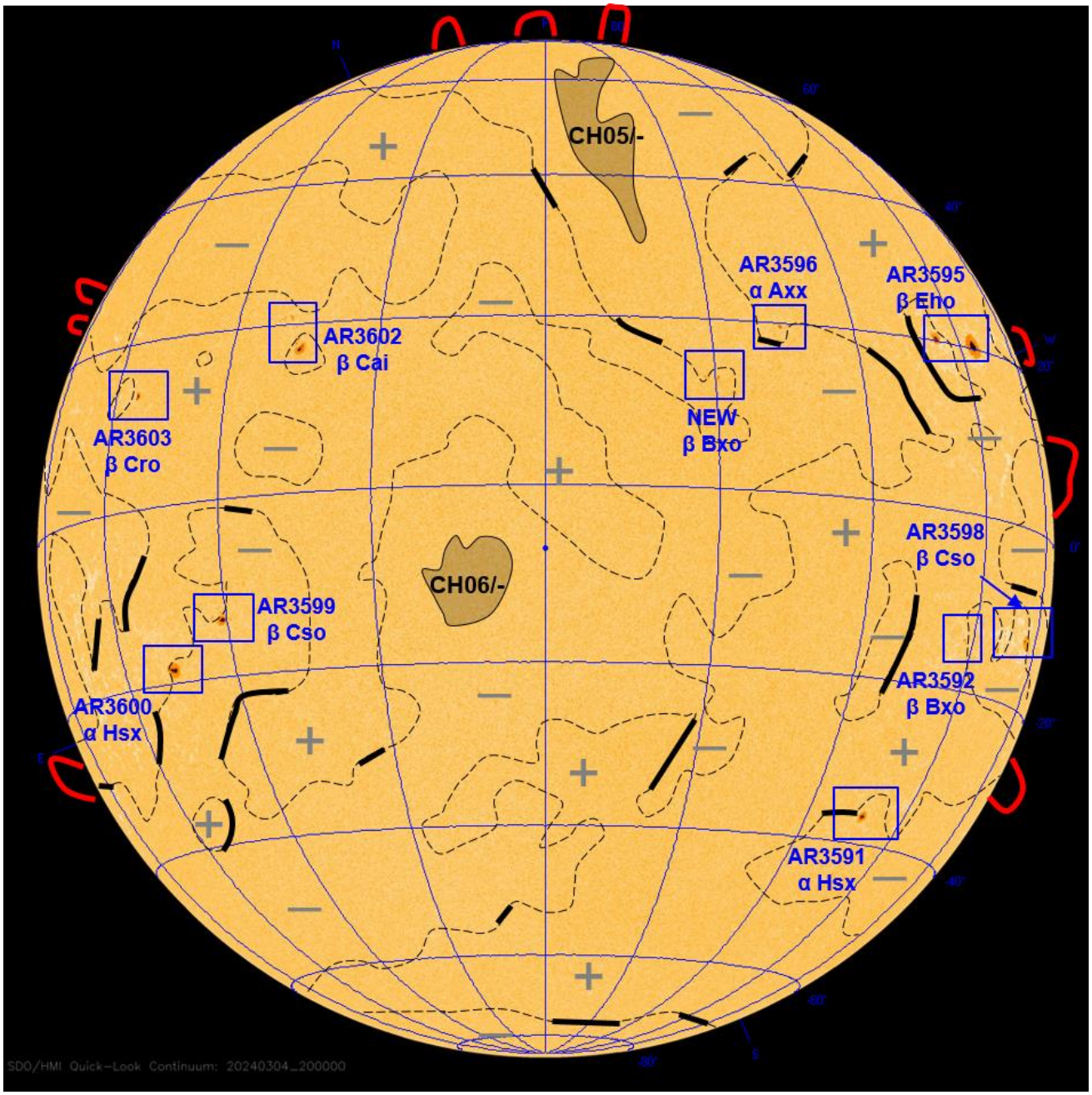
Energetic Particles / Solar Radiation: GOES18 high energy proton flux is expected to persist at background levels, but with a very slight chance of rising above the S1/Minor Radiation Storm threshold should any significant flares occur from the numerous sunspots that occupy the western disc. GOES16 high energy electron flux is expected to remain at background, occasionally moderate levels, with the associated 24hr fluence remaining well below the Active threshold.

Figure 1. Solar Analysis Valid 04/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A southward directed CME resulting from a small filament liftoff in the vicinity of AR3591 on 03 Mar has a chance to give glancing impacts at Earth on Day 3 (07 Mar). No other CMEs feature in the forecast period.

Residual effects from one or more combined CMEs that arrived at Earth early on 03 Mar should diminish on Day 1 (05 Mar). Slow-ambient to slightly elevated speeds are expected to persist until the onset of a high-speed stream, most likely late on Day 4 (08 Mar) from CH06/- located near centre disc close to the solar equator. Indications are that this is a new feature on this rotation, therefore estimated peak speeds and onset timings carry more uncertainty than usual. Persistently slightly elevated to elevated speeds at peak are forecast and given the negative polarity of the coronal hole, which is favourable for geoeffective enhancements at this time of year (Russell-McPherron effect), this supports stronger than usual geomagnetic effects.

Quiet to Unsettled geomagnetic activity is expected Day 1 (05 Mar), easing to Quiet from Day 2 (06 Mar). Activity may increase on Day 3 (07 Mar) with a chance of Unsettled to Active intervals and a slight chance of peak G1/Minor Storms if any CME enhancement occurs. On Day 4 (08 Mar) activity should increase late in the day to become Unsettled to Active, with a slight chance of G1/Minor Storm conditions.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	10	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
03/1730 UTC	Partial	Filament Eruption	Near AR3591 (SW)	500 km/s	07/0600 UTC	Low confidence, glancing blow

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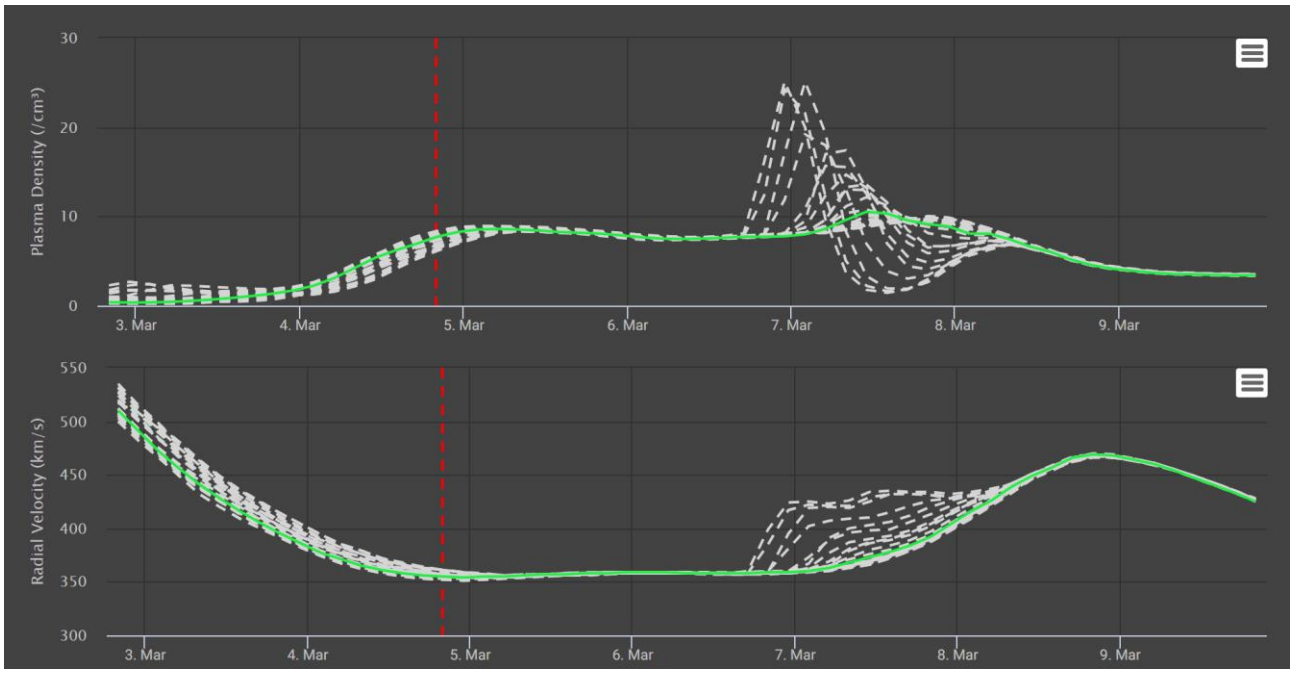
Figure 2: MOSWOC Enlil Ensemble indicating chance of enhancement from CME on Day 3 (07 Mar)



Radio Blackouts - X-Ray Flares:

There are currently ten sunspots on the visible disc, with nine numbered regions and one unnumbered region. AR3595 in the northwest is the largest spot on the disc, however, there has been little change in overall appearance with a large and stable leader and smaller trailer region, but few other spots. In the northeast, AR3602 contains a moderately sized lead spot and a poorly defined trailer region with numerous small pores or spots. The region is atypical due to its north-south magnetic alignment and negative polarity leader for a northern hemisphere group (suggesting an Anti-Hale configuration). The remaining regions appear much simpler and are stable at this time.

Low activity is expected, but with a chance of isolated Moderate-class flares. The majority of this risk is contributed to by AR3595 and AR3602. In the absence of any further spot development or new regions rotating over the eastern limb, the risk of significant flares reduces to a slight chance of Moderate flares during Day 3 (07 Mar) into Day 4 (08 Mar) as AR3595 passes beyond Sun's western limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	20
Very Active	R3 to R5 X Class	No	1	1	1	1

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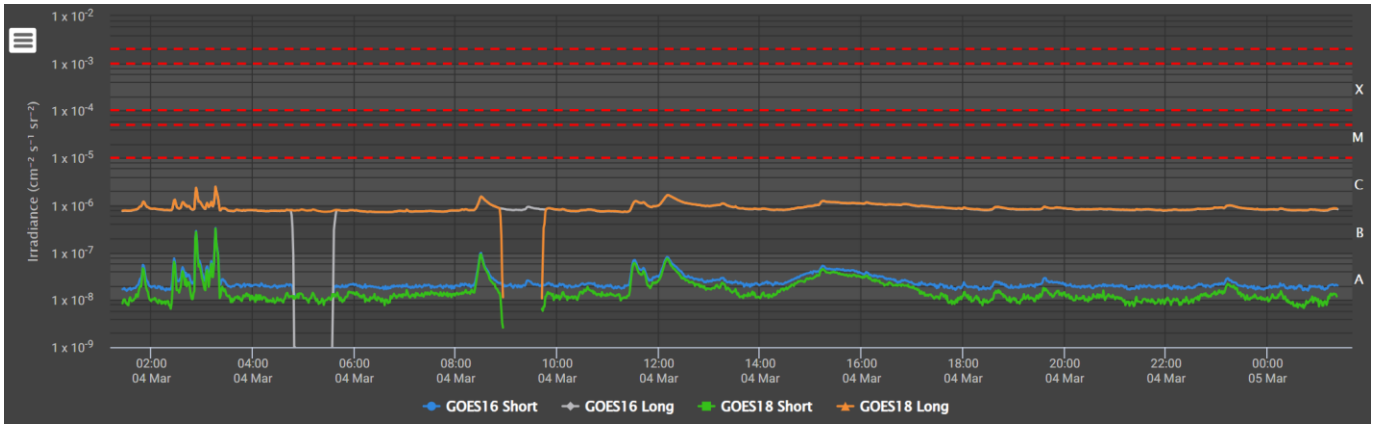
Figure 3: 24-hour GOES 16/18 X-Ray flux



Solar Radiation Storms - (High Energy Protons):

GOES-18 proton flux is currently at background levels, and is expected to remain so through the period. There is just a very slight chance of rising above the S1/Minor Radiation Storm threshold should any significant flares occur from the numerous sunspots that occupy the western disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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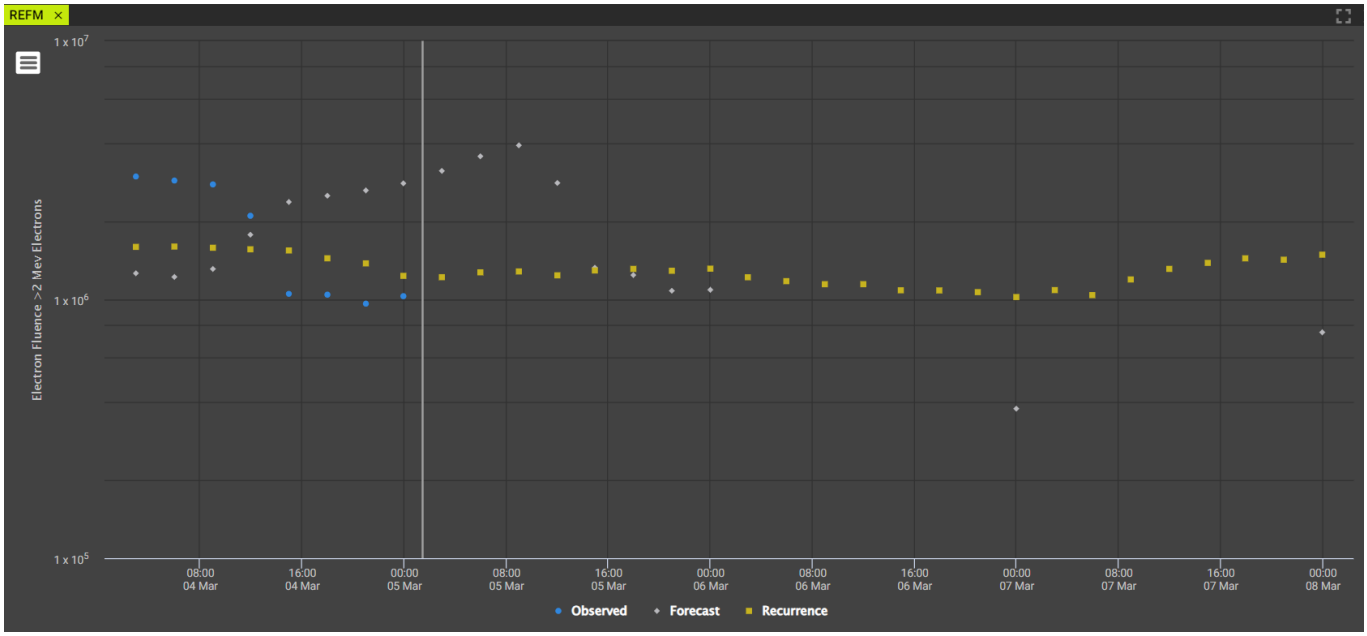
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to remain generally at background, occasionally moderate levels in the absence of any significant solar wind or CME inputs.

Corresponding high energy electron fluence is expected to remain well below the Active threshold (1e8 integrated pfu), but with a slight rising trend probable towards the end of the forecast period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM output with recurrence



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